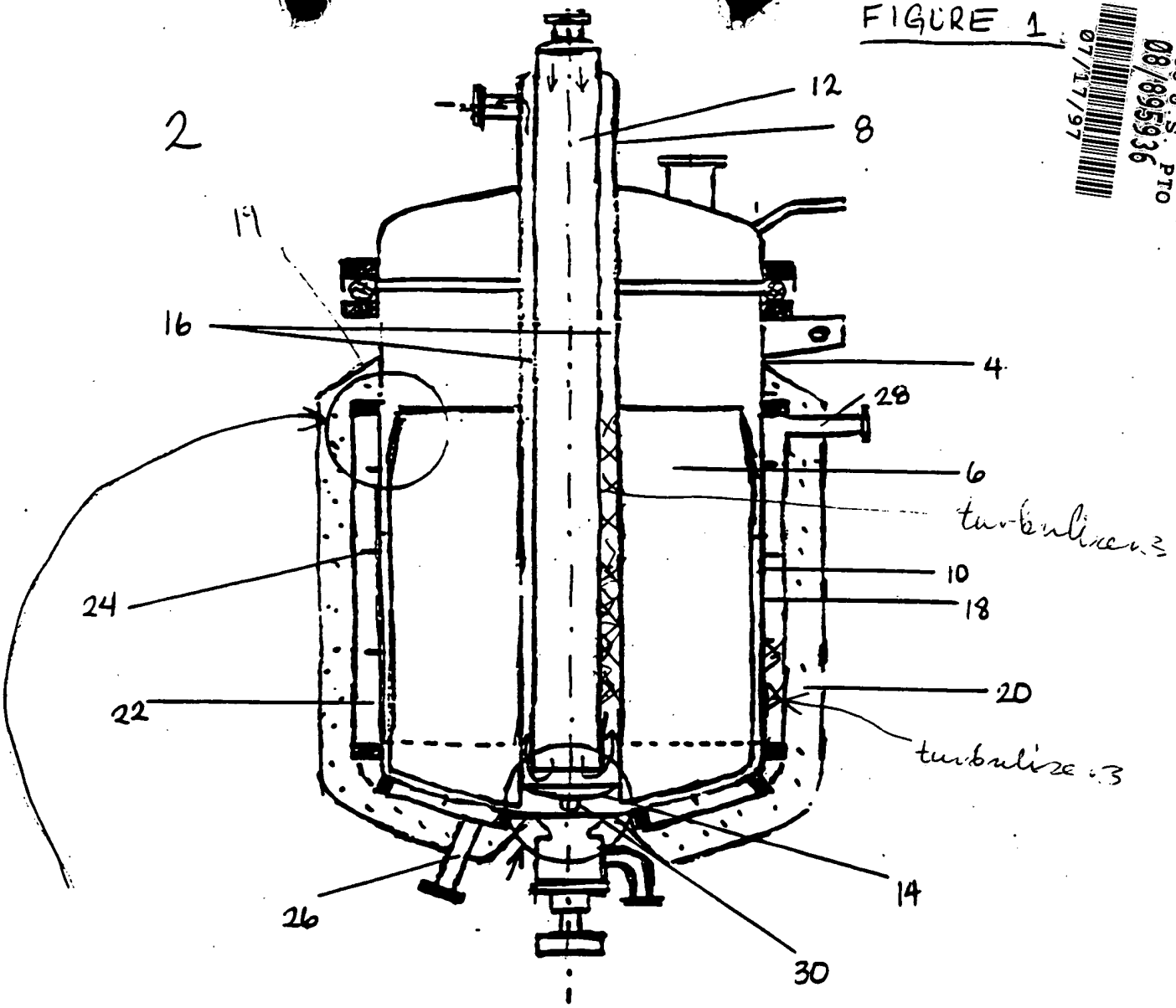
FIGURE 1



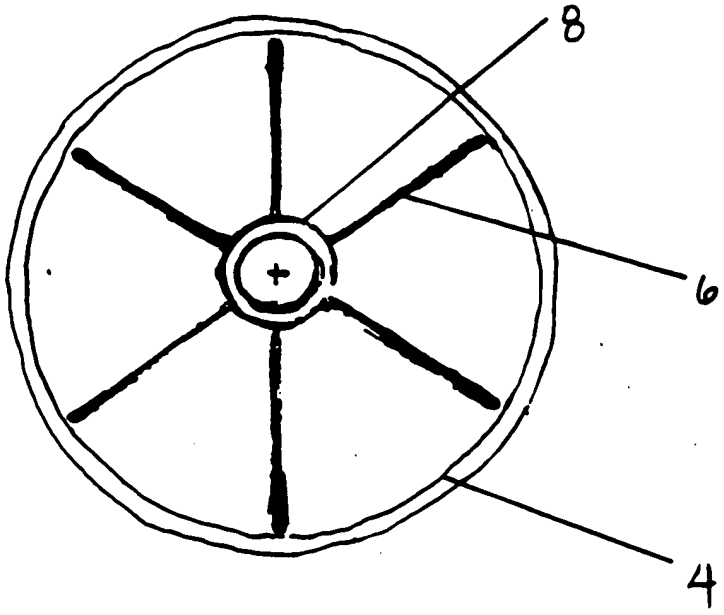


FIGURE 2

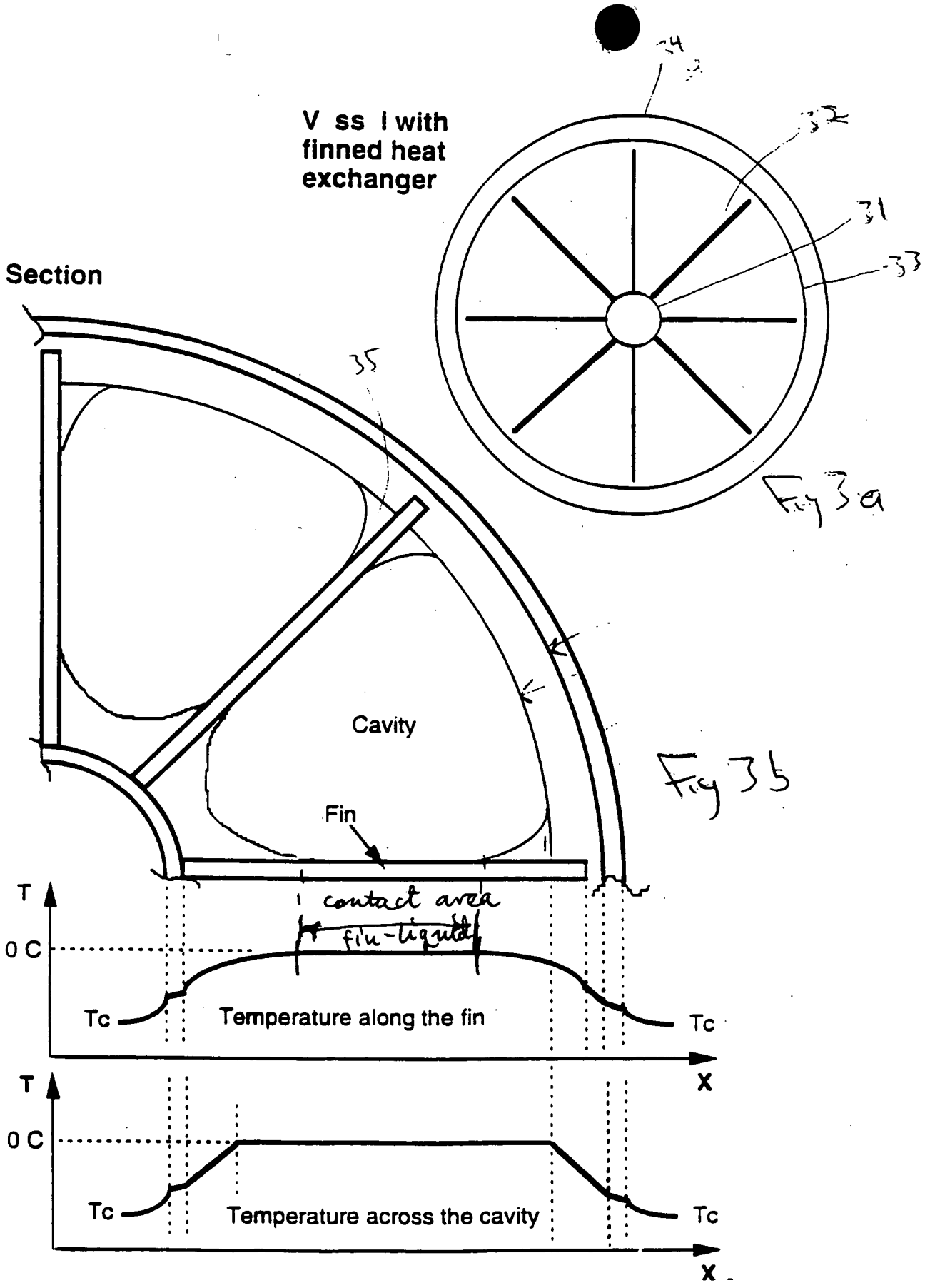
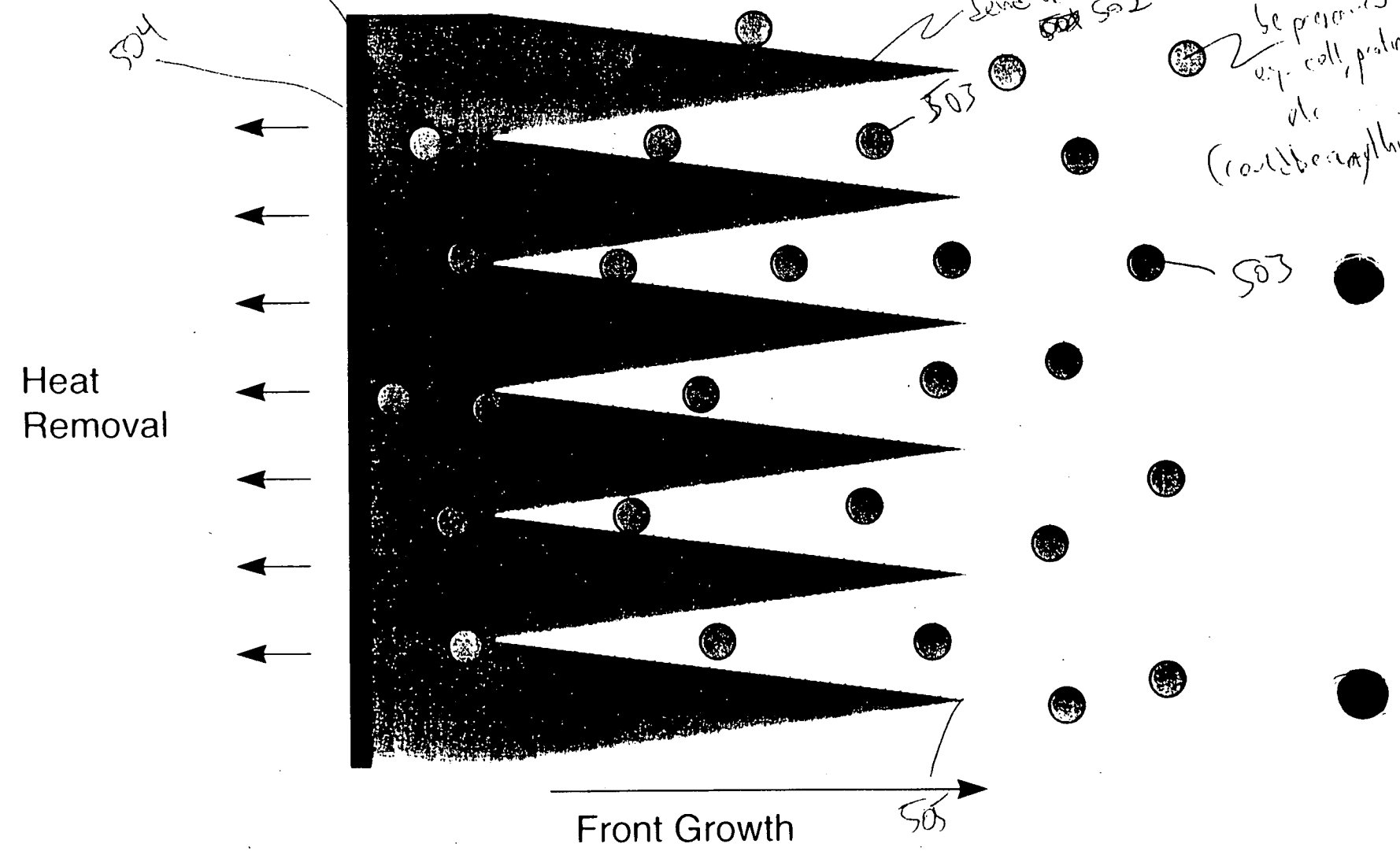

V ss l with finned heat exchanger
Section
34
32
31
33
35
Cavity
Fin
T
0 C
Tc
contact area fin-liquid
Temperature along the fin
Tc
X
T
0 C
Tc
Temperature across the cavity
Tc
X

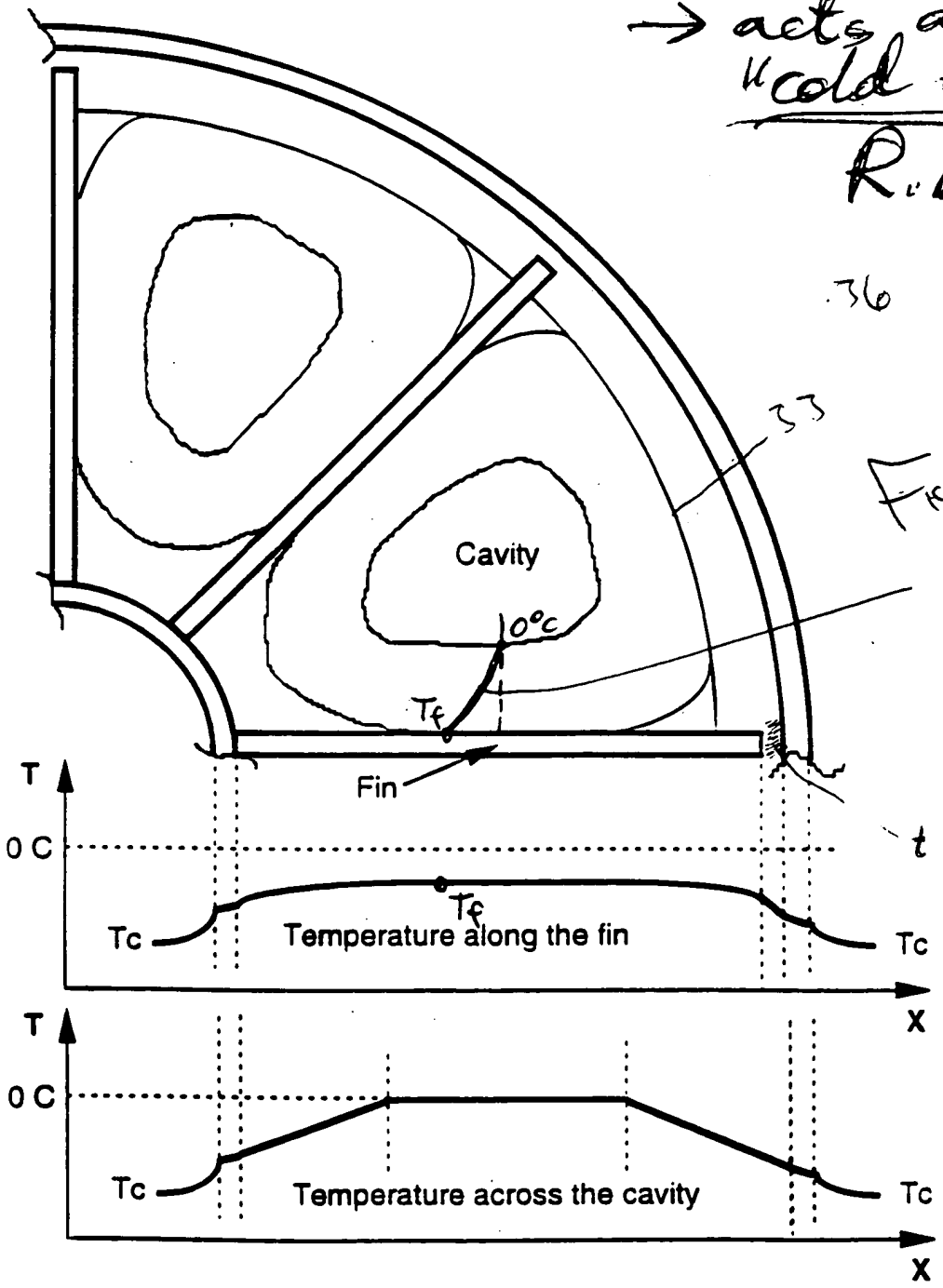
Fig 3a

Fig 3b

Dendritic Ice Growth



Section of the vessel with internal finned heat exchanger



→ acts as a "cold wall"

R. W.

36

33

Fig 3c

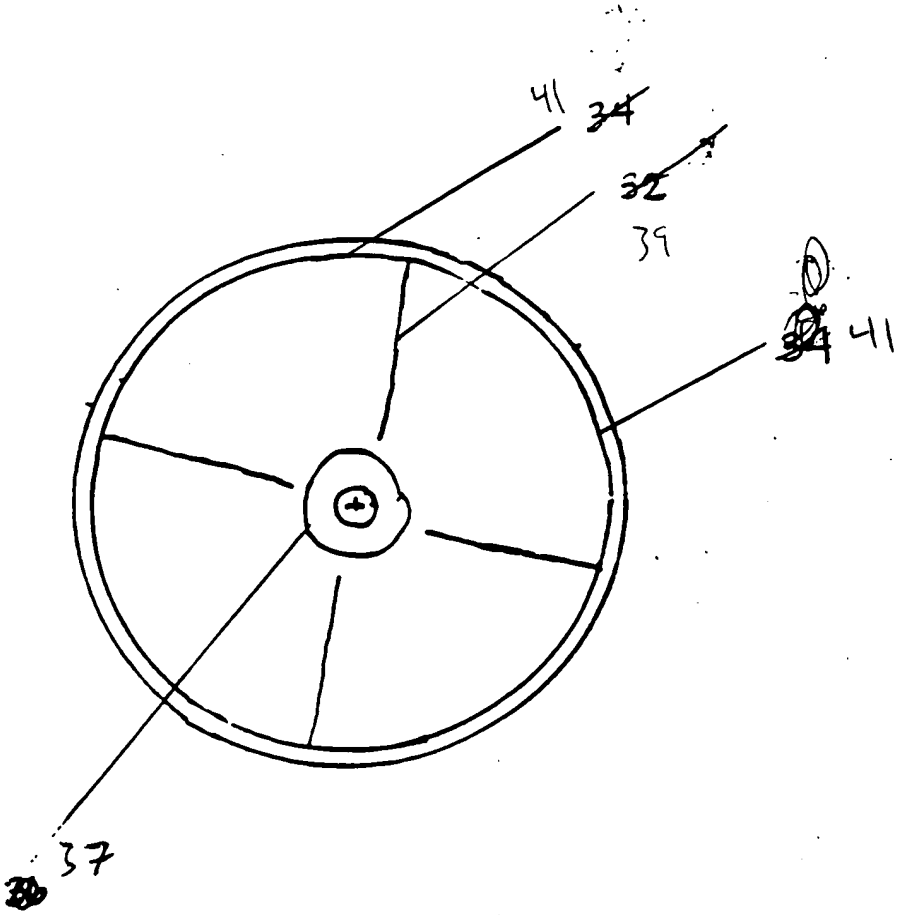
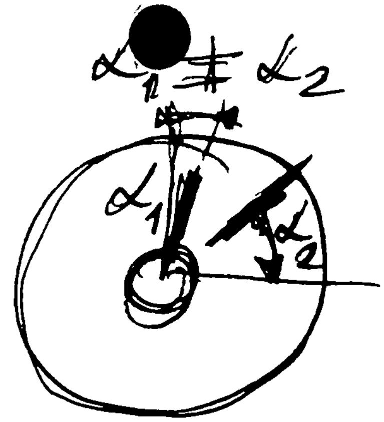


FIGURE 34


$\alpha_1 \neq \alpha_2$
α_1
α_2

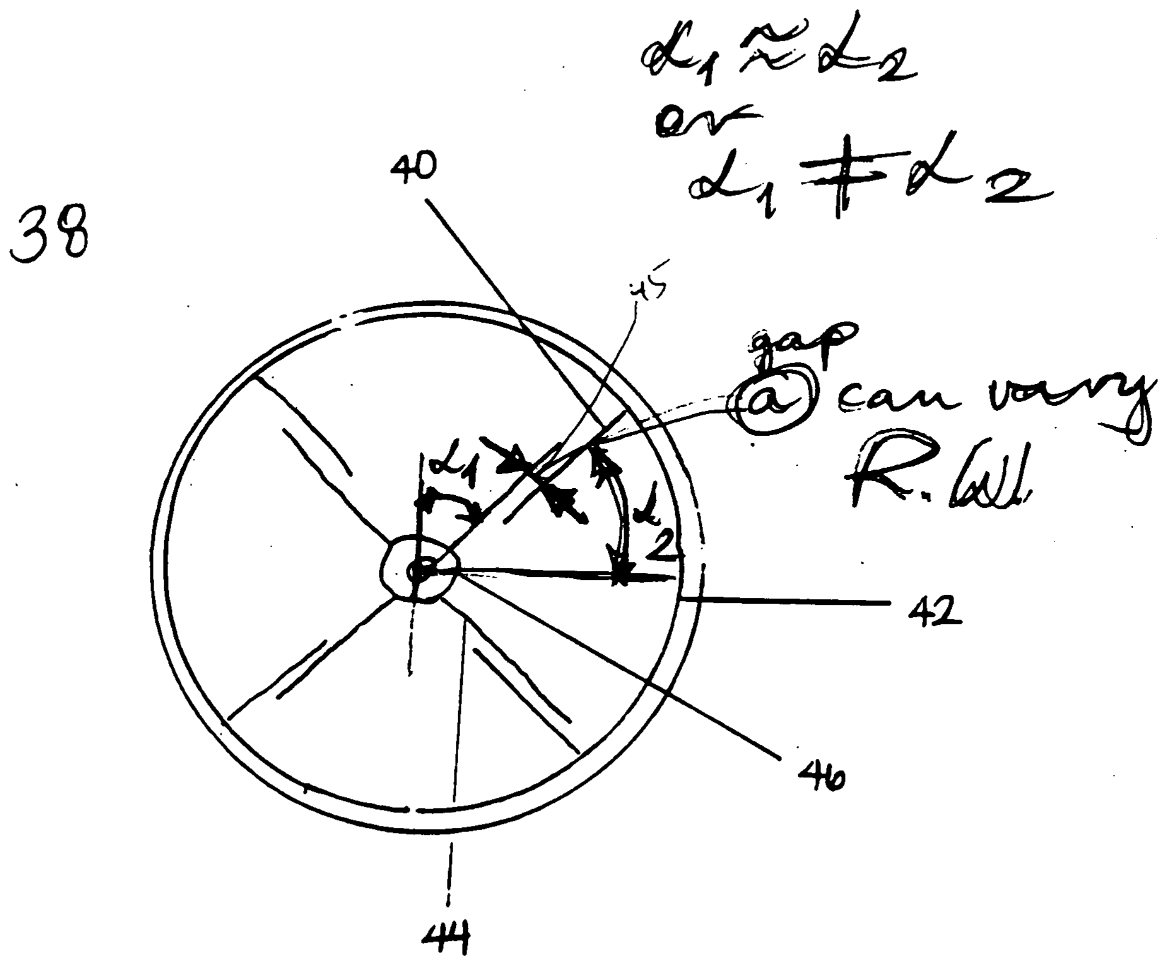

$\alpha_1 \approx \alpha_2$
or
$\alpha_1 \neq \alpha_2$
38
40
45
gap
(a) can vary
R. W.
α_1
α_2
42
46
44

FIGURE 5

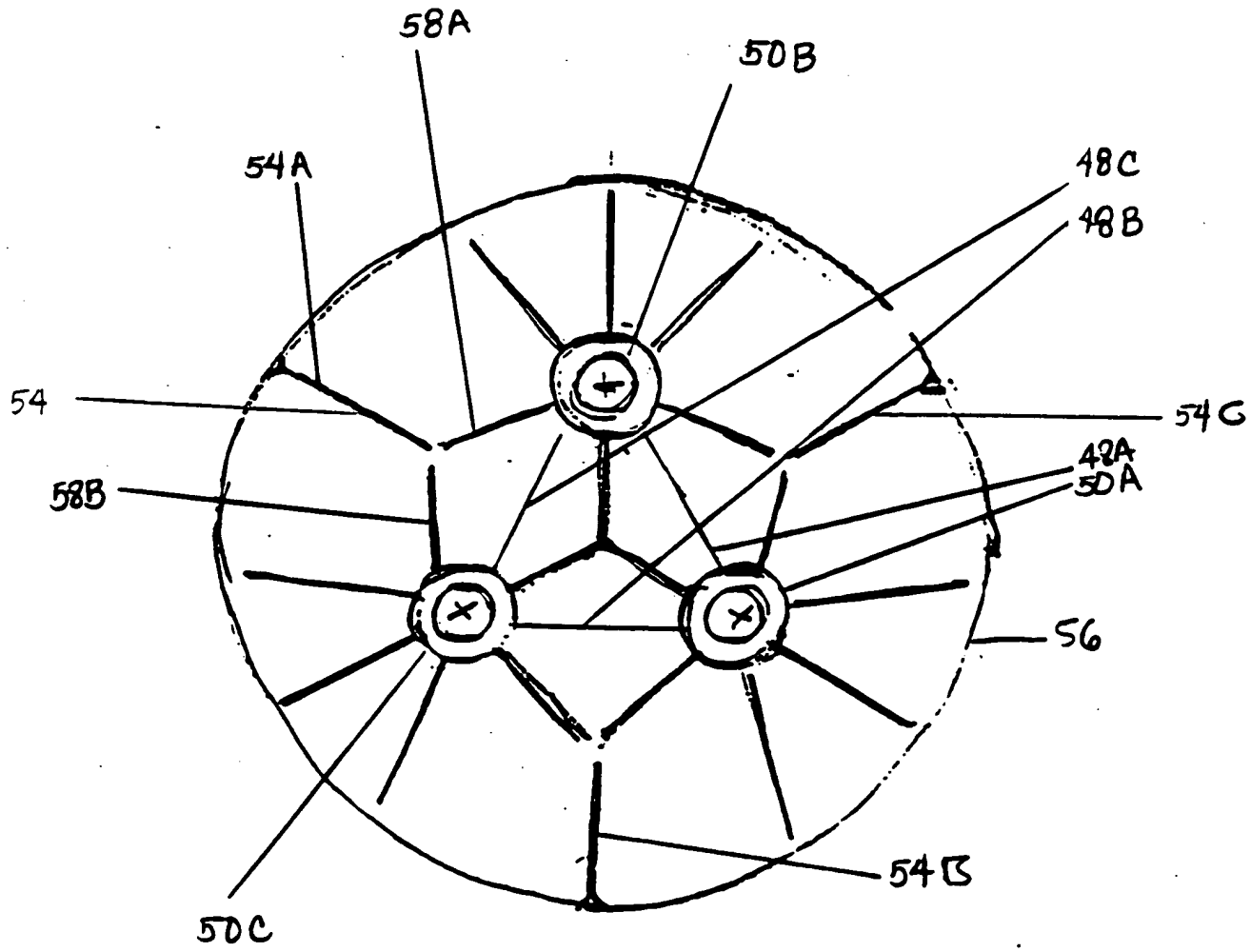


FIGURE 6

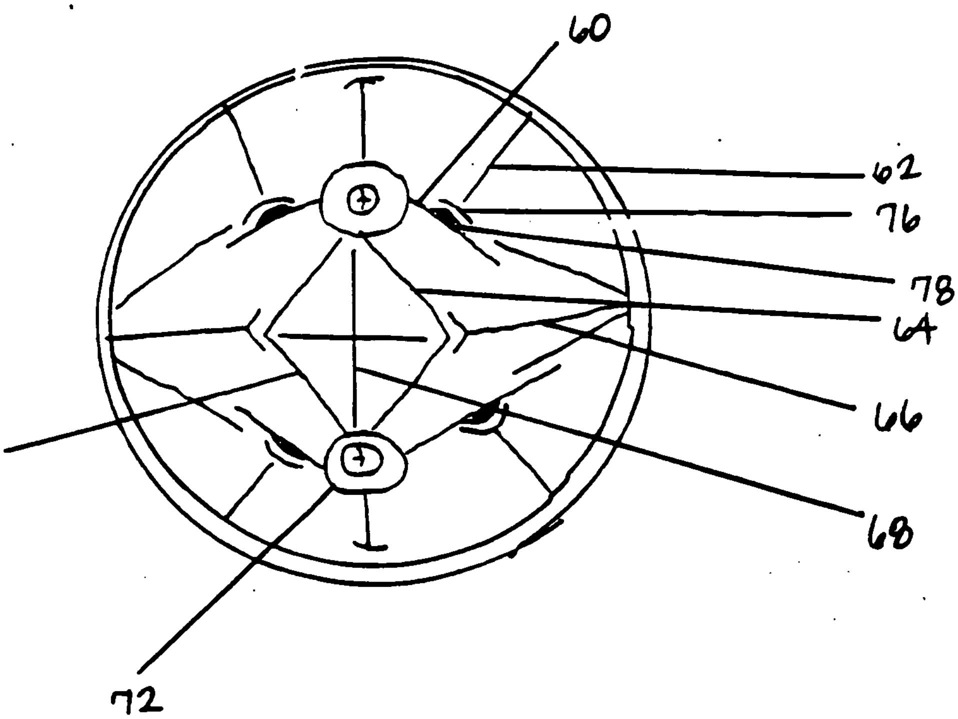
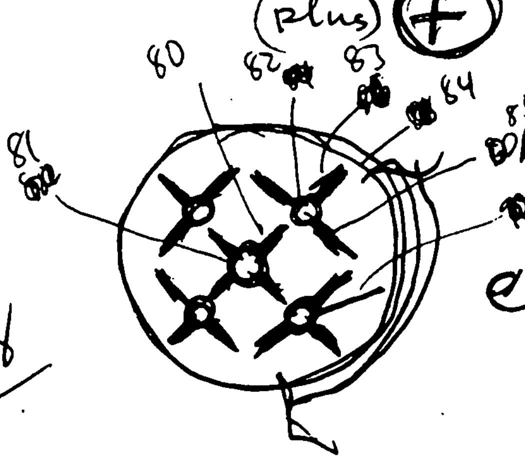


FIGURE ~~6~~ 7

(plus) (+) Other combinations (for sake of the disclosure) R.W.



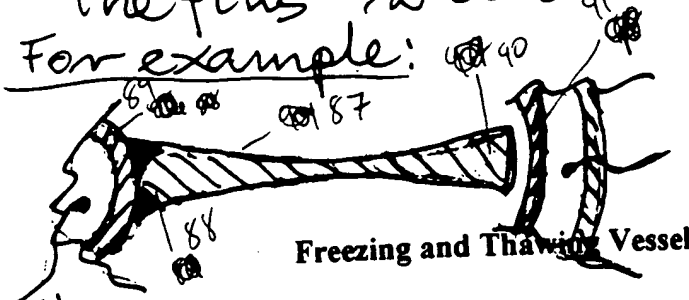
etc. R.W.

Fig 8

(started in pencil R.W.)

General: Include in descriptions the fins with change in thickness R.W.

For example:



PATENT
Attorney Docket
No. 17882.702

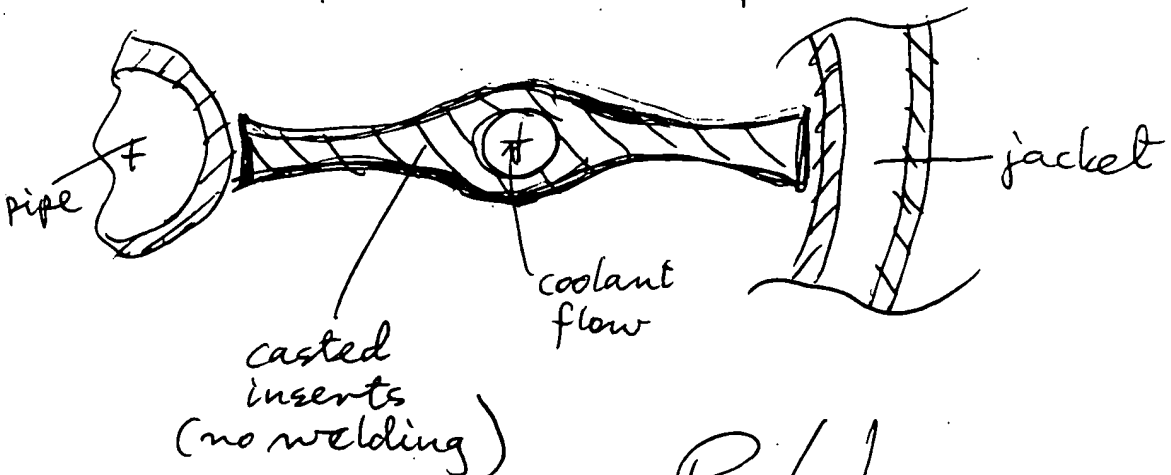
Freezing and Thawing Vessel with Hollow Fins and Baffles

Inventor: Richard Wisneiwski

1. Field of the Invention

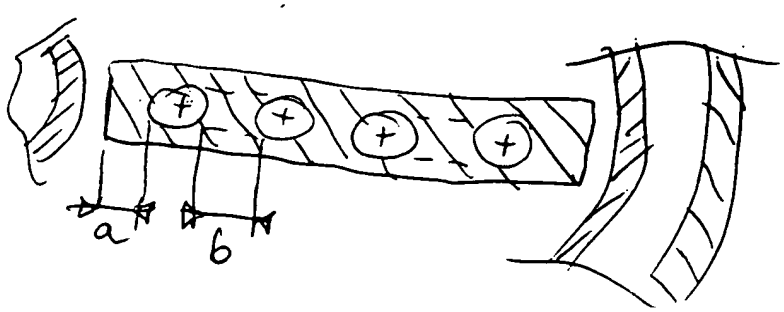
Fig 9

Also a profiled fin

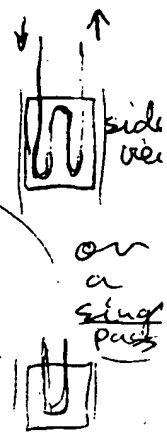


R.W.

Casted inserts can be simpler



a = b
or a ≠ b



BY: R. WISNIEWSKI

June 16, 1997

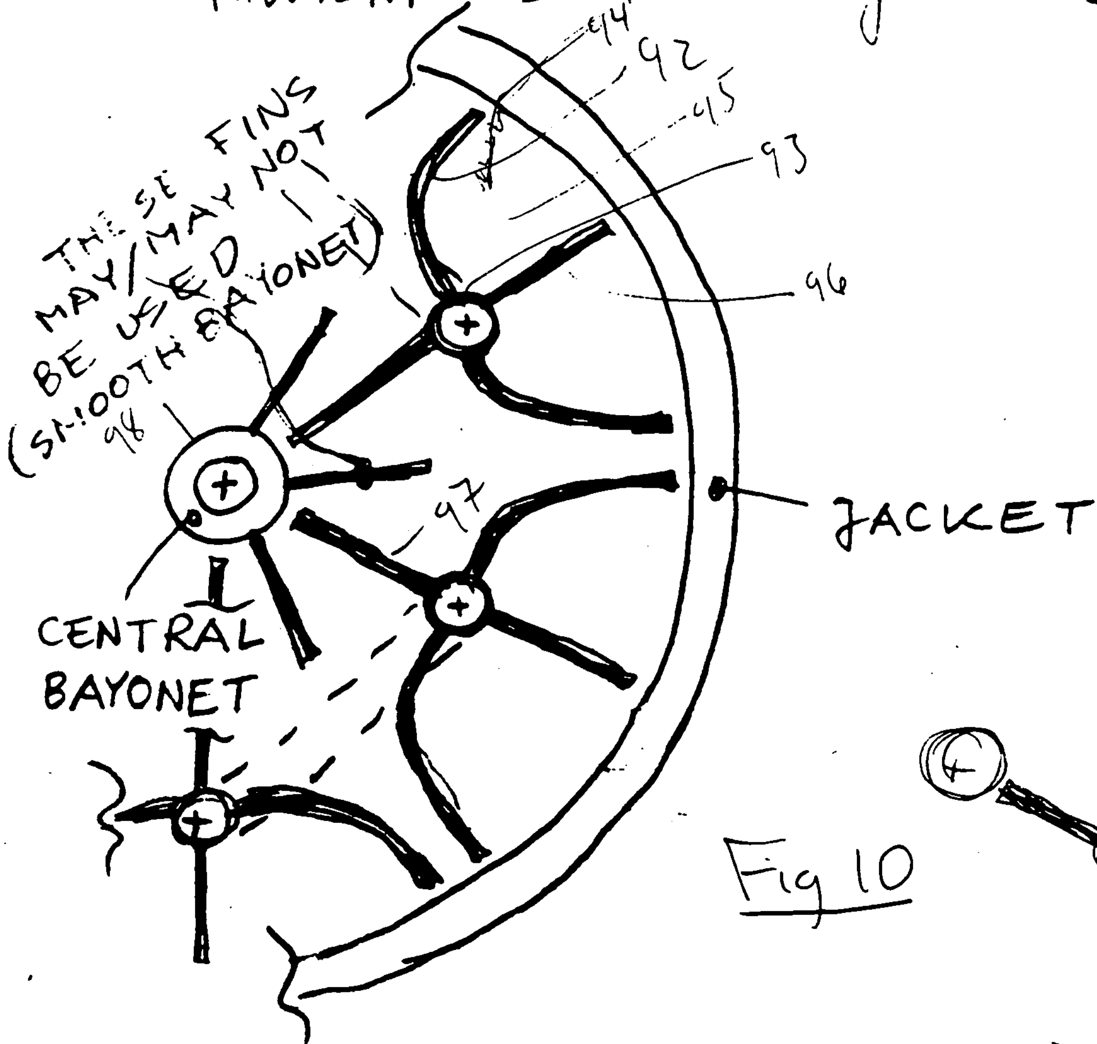
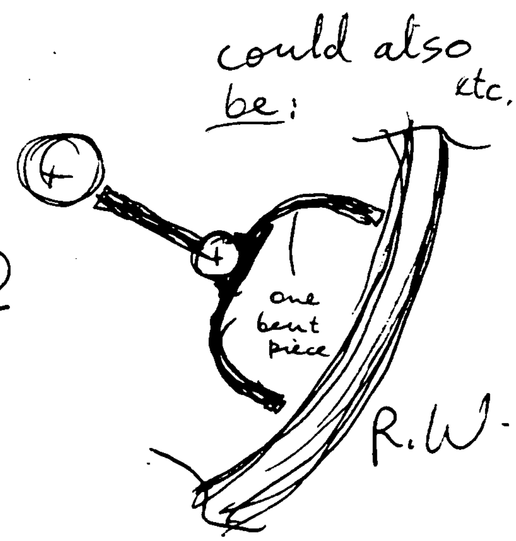


Fig 10



CONCEPT OF CREATING COMPARTMENTS USING BENT FINS.

Richard Wisniewski

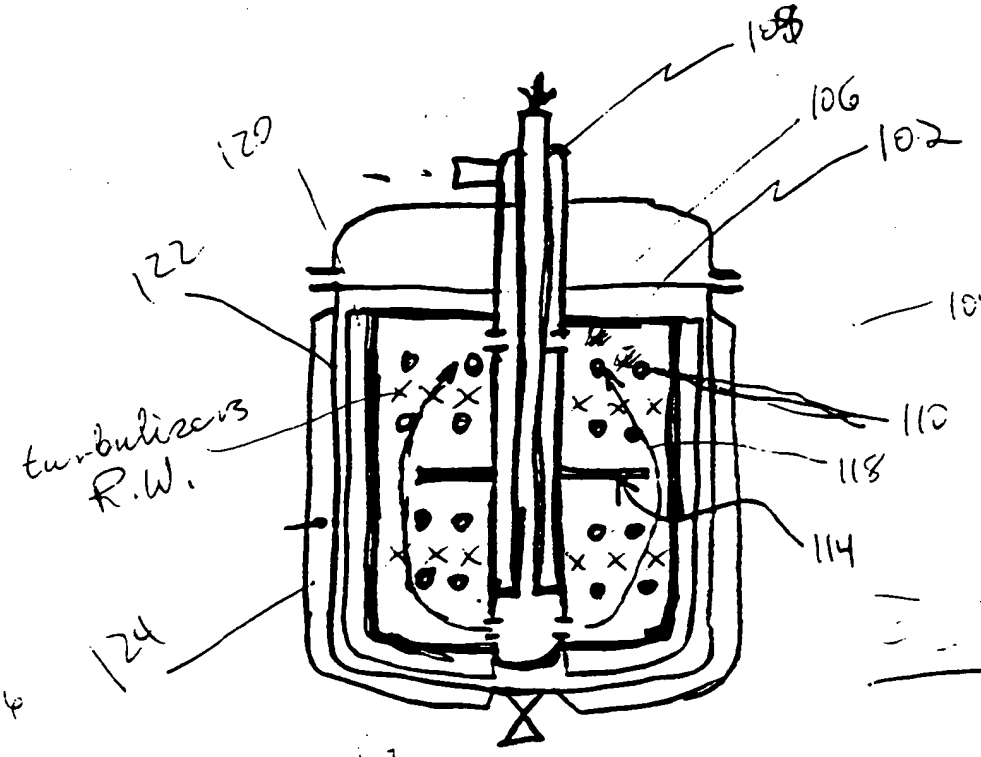


Fig. 11

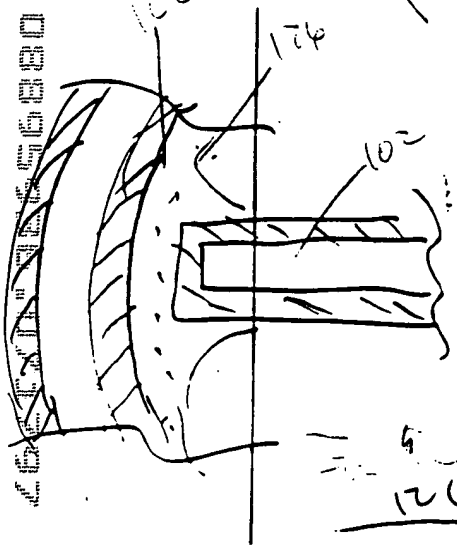


Fig. 12C

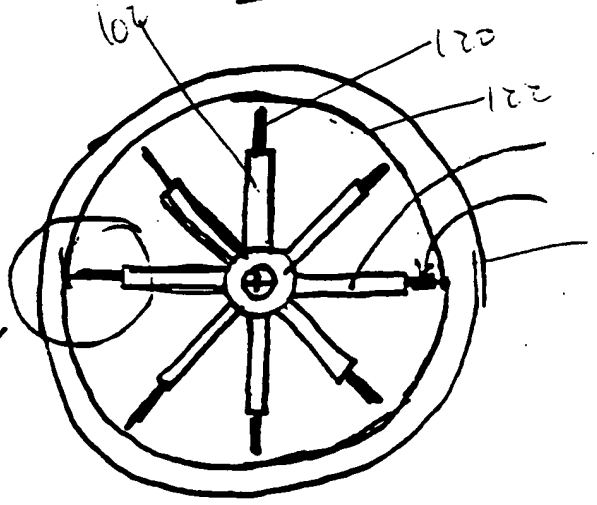


Fig. 12A

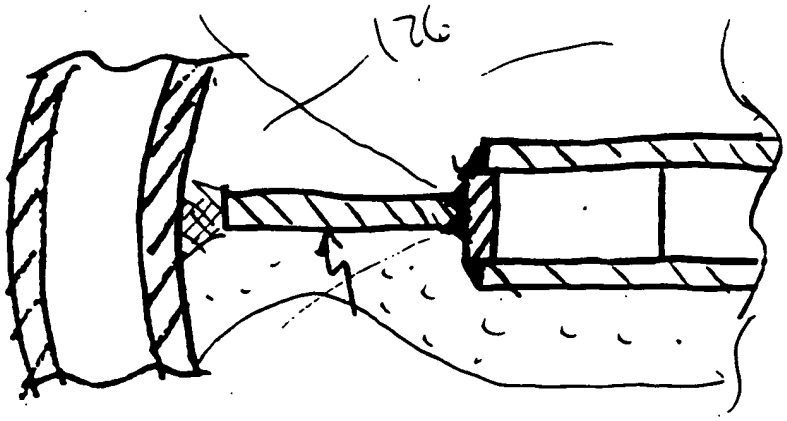
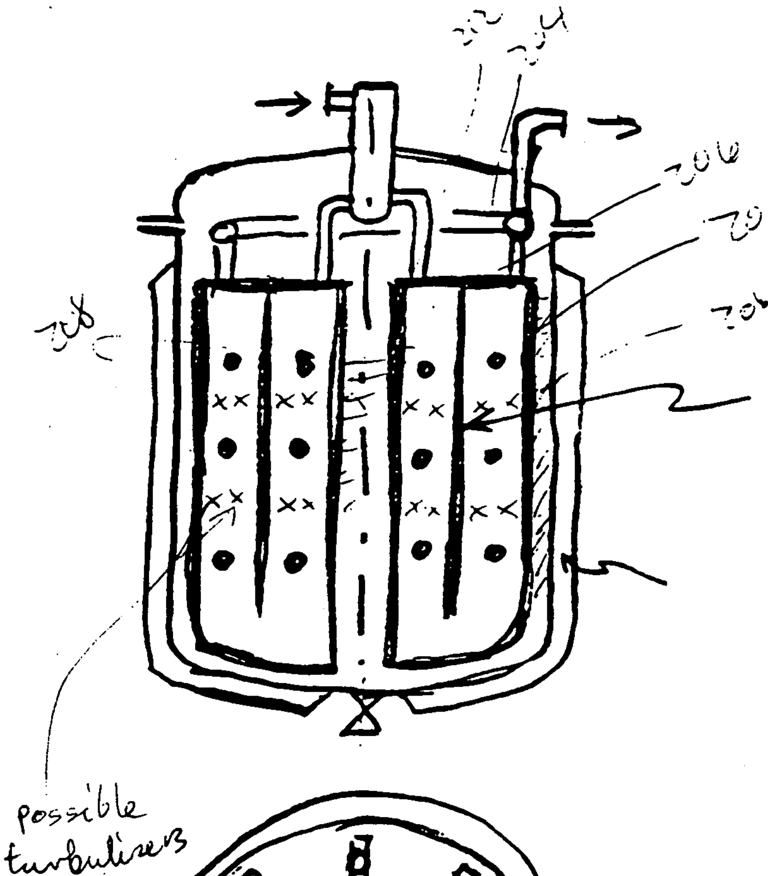
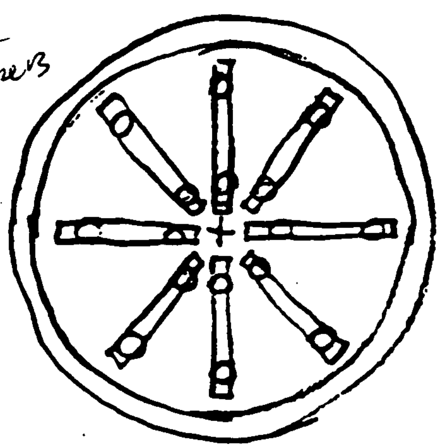


Fig. 12B

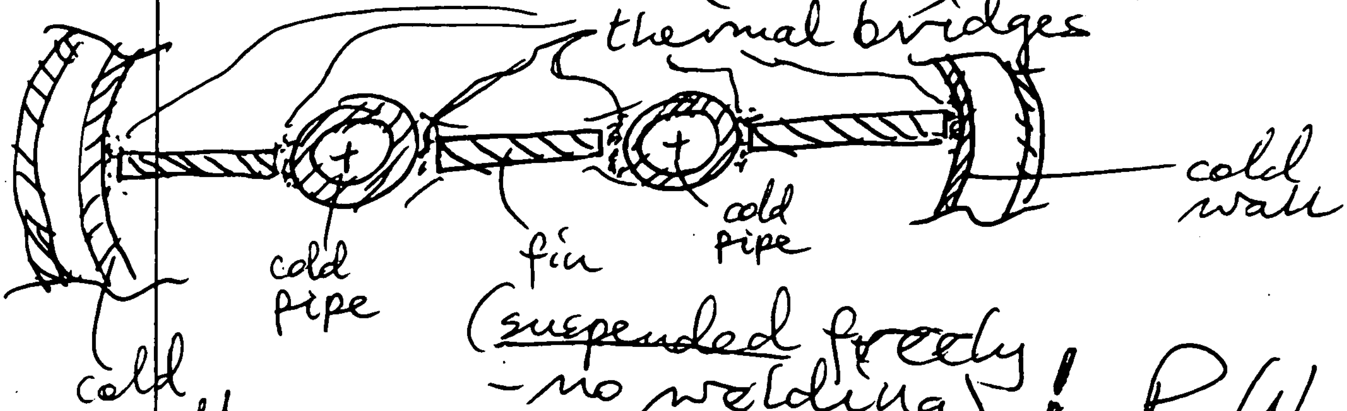




Plates

R.W.

Another (new) interpretation



(suspended freely - no welding) ! R.W.

see 68 Fig 6

"Bubble thermal bridges: Between pipes and between pipes and fins R.W.

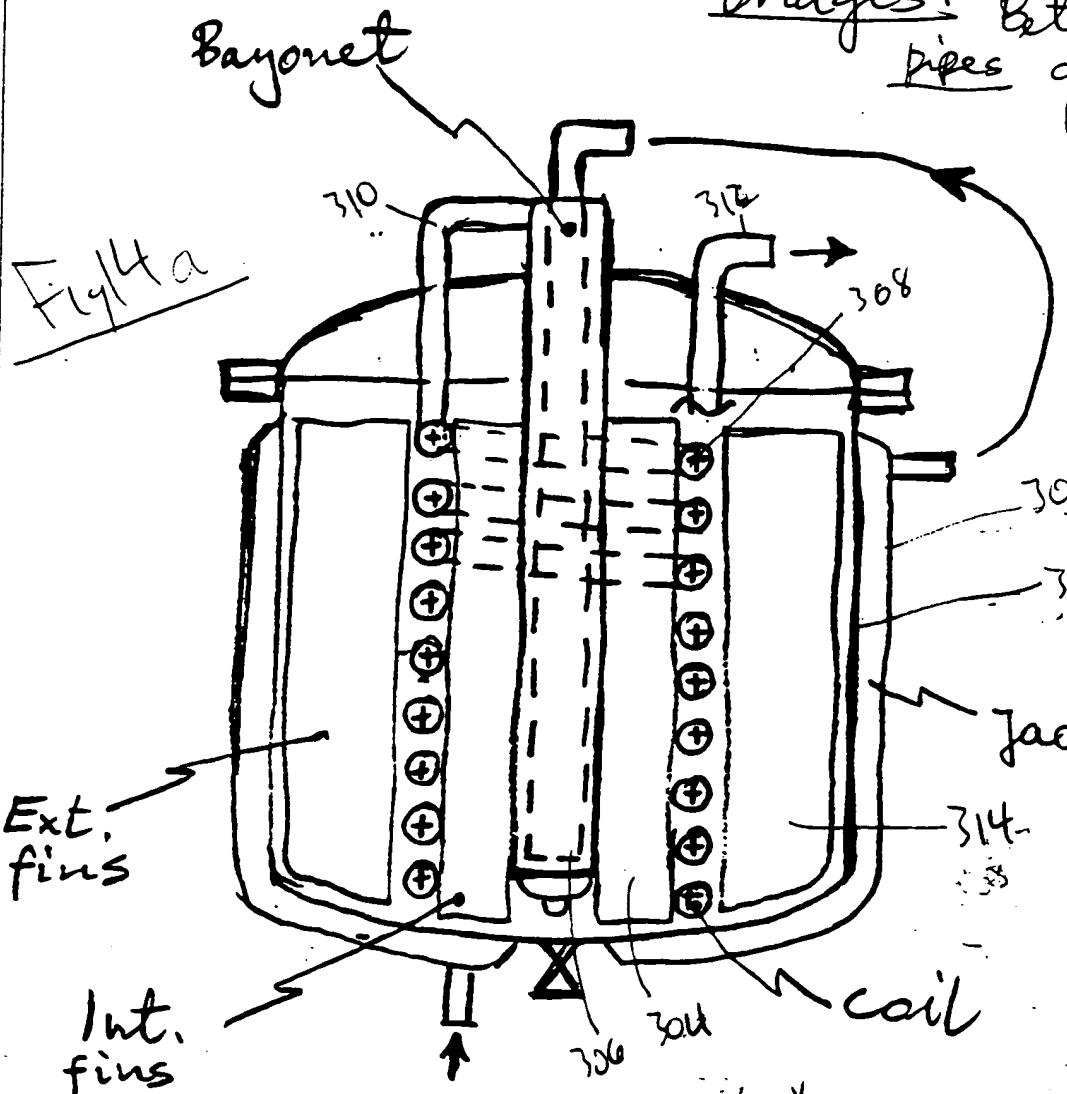
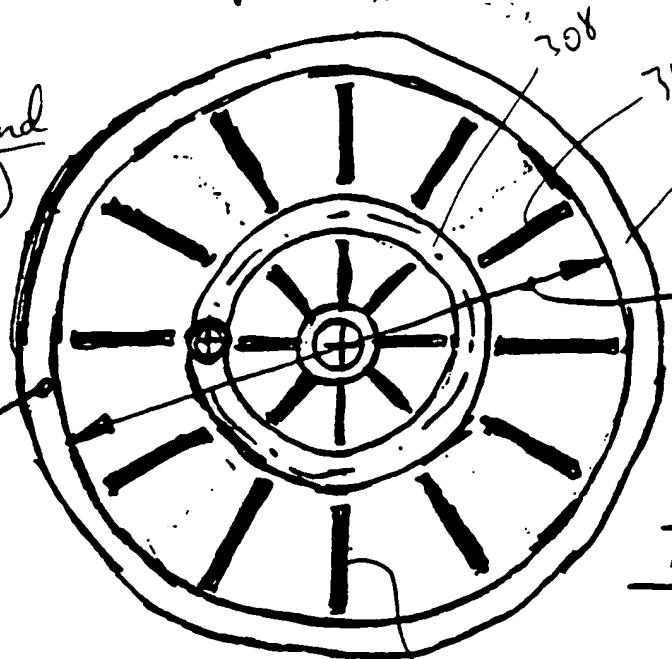


Fig 14a



Top view

Do include other than round pipes (oval, etc)

suspended fin R.W.

Very large diameter vessel

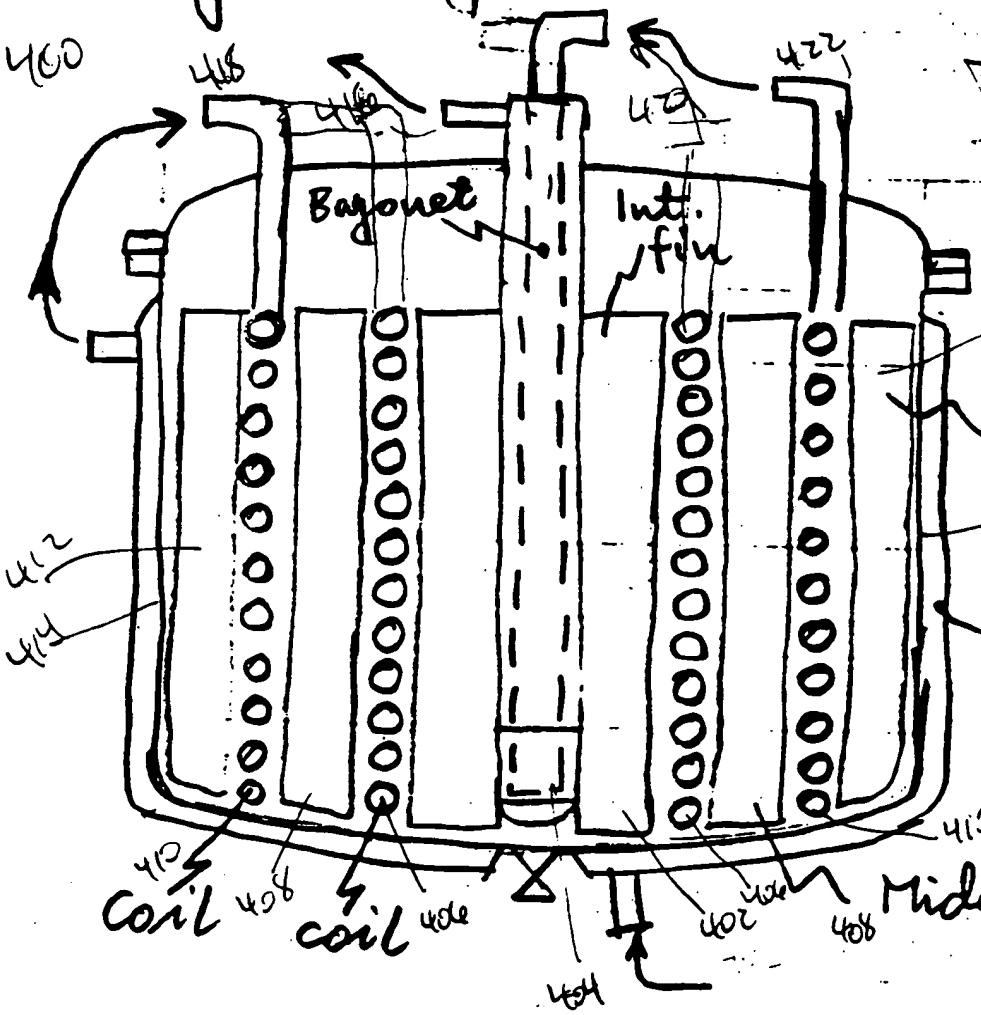


Fig 15a

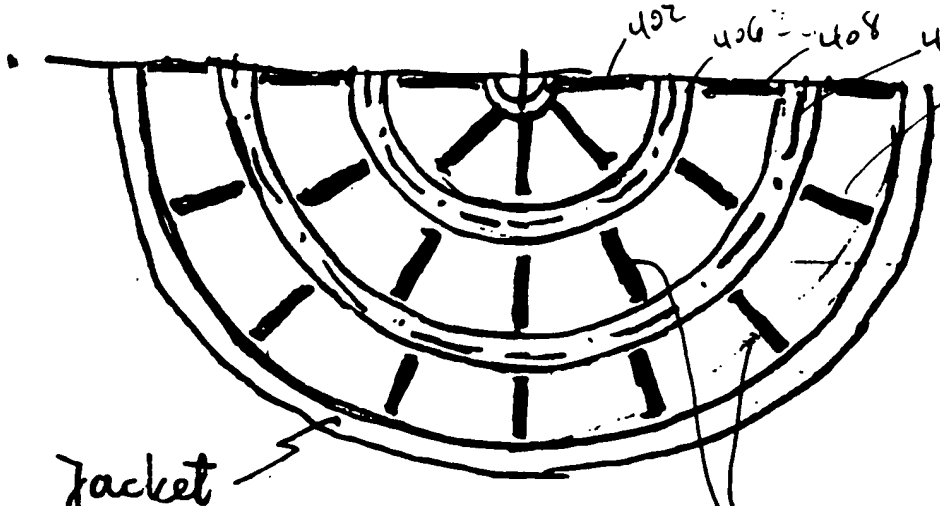


Fig 15b

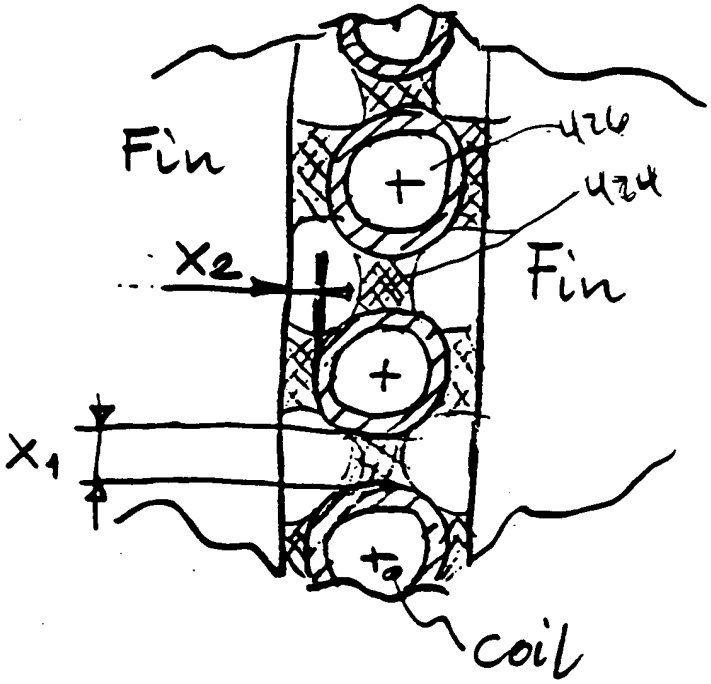
freely suspended fins (double bridging)

R.W.

Double thermal bridges

R.W.

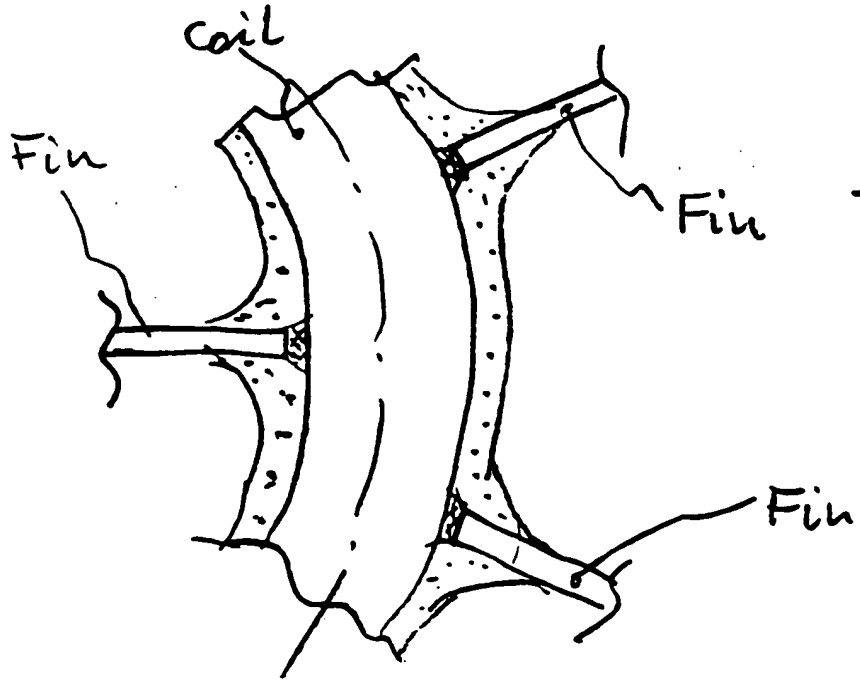
Details:
Thermal bridges:



IEC

Thermal bridges of solidified material

X_1, X_2 - optimized



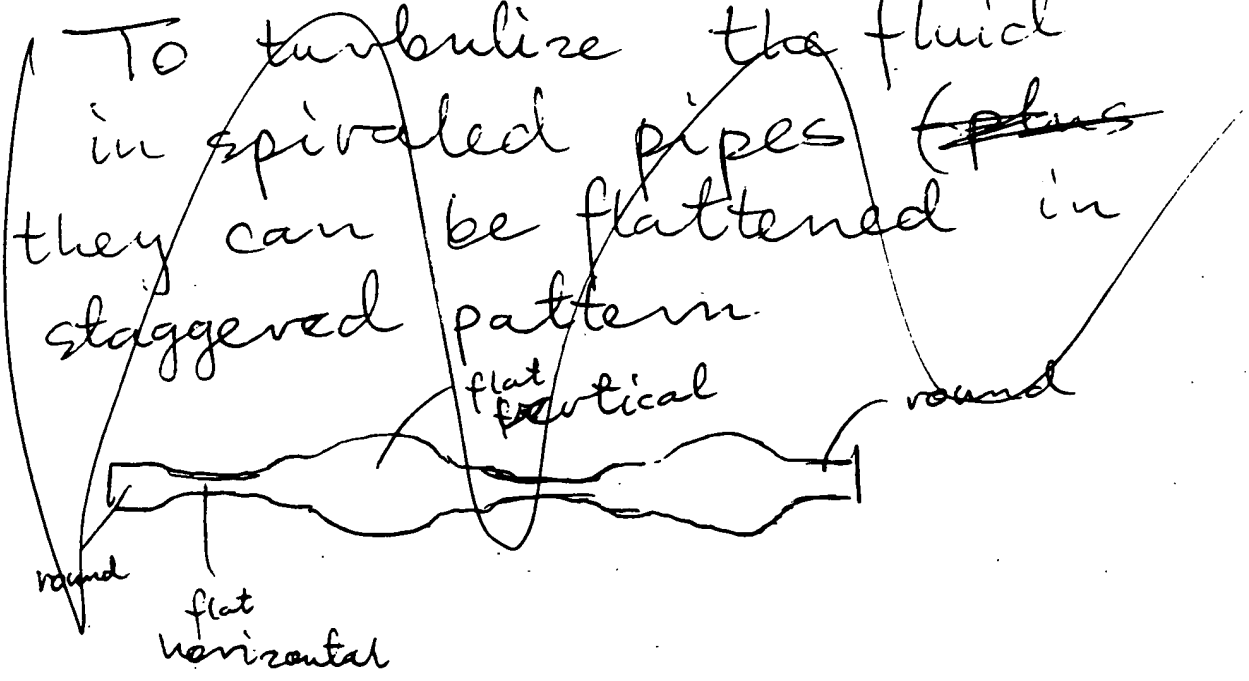
Top view

ISO

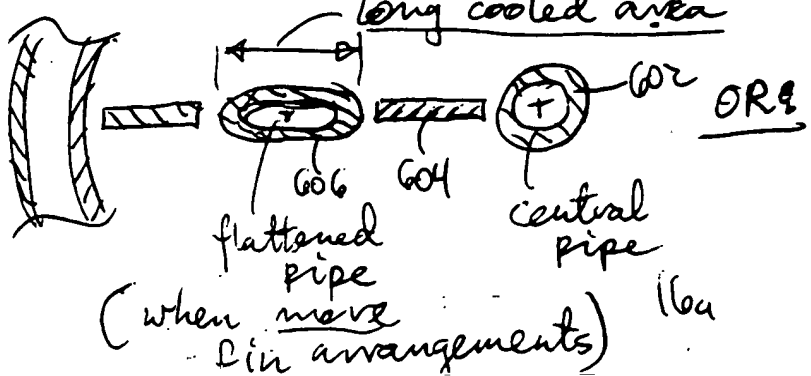
Here: also pipes flattened/oval/square

over →

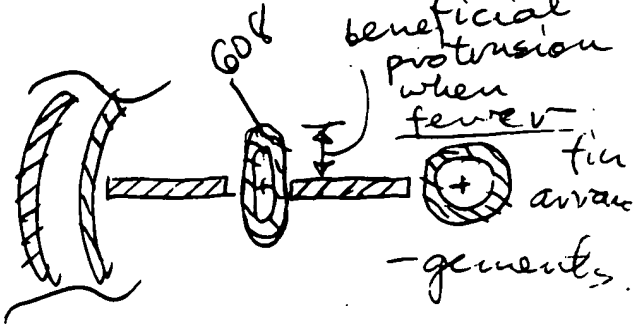
To turbulize the fluid in spiraled pipes ~~(plus~~ they can be flattened in staggered pattern



(16) Therefore: do this (flattened or oval/square pipe

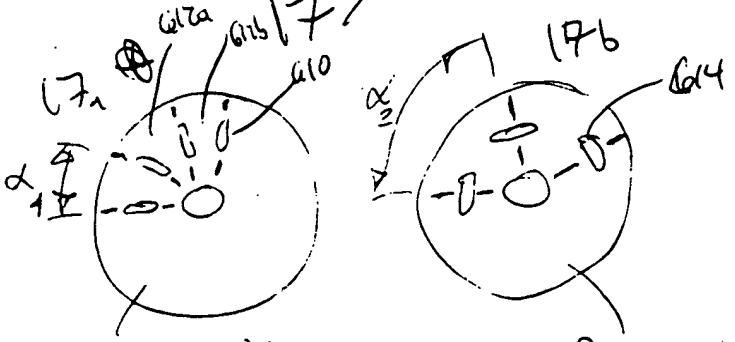


(when more fin arrangements) 16a



16b (see the

Flattened / oval / square pipes:



many fin assemblies (α_1 small)

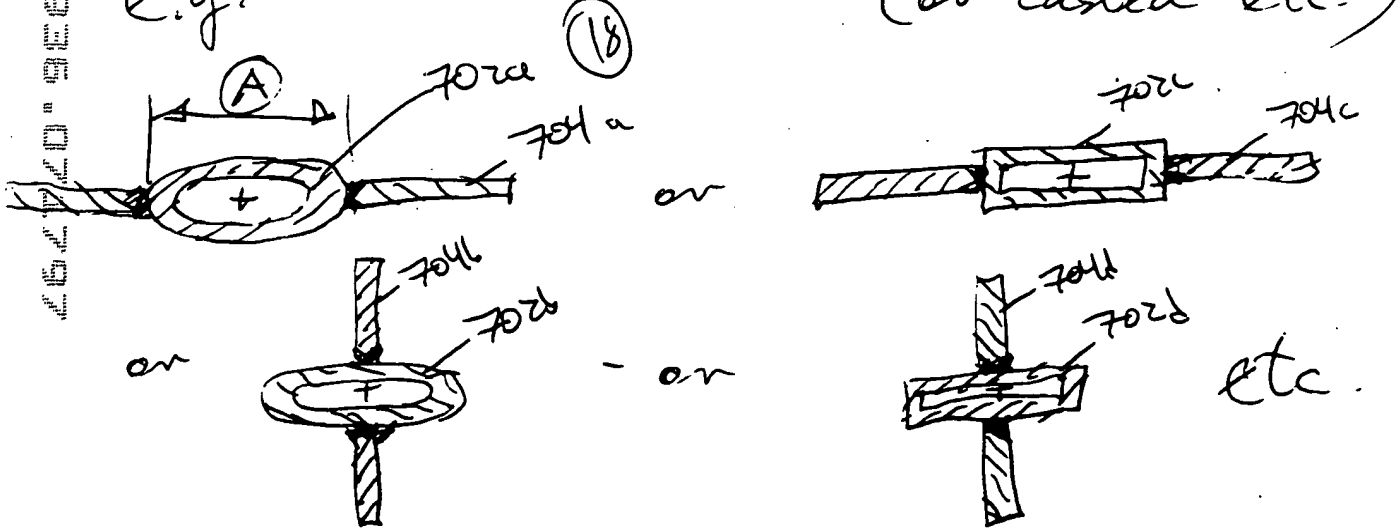
fewer fin assemblies (α_2 large)

Advantage of such pipes → longer (A) dimension → better compartmentalization of space

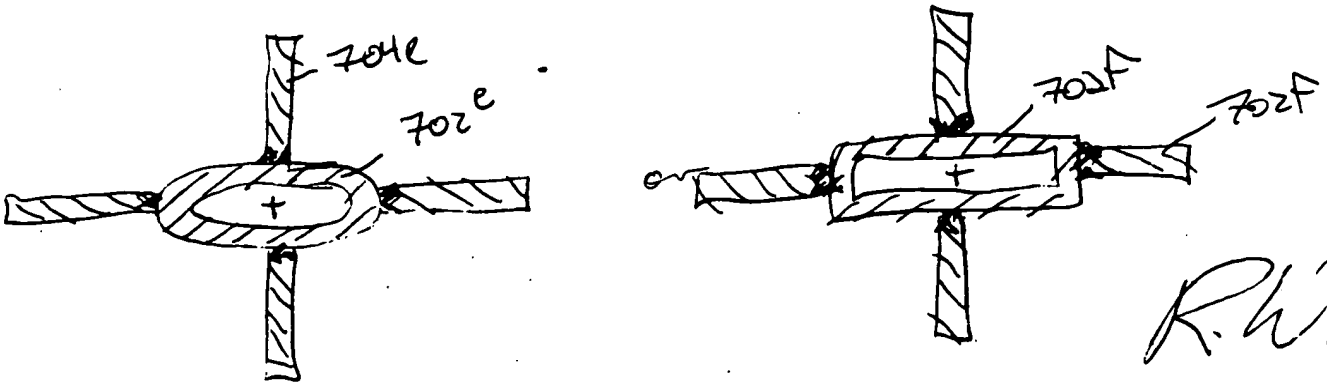
"long" areas directly cooled!

Also – flattened / oval / square pipes with welded fins (or casted etc.)

e.g.

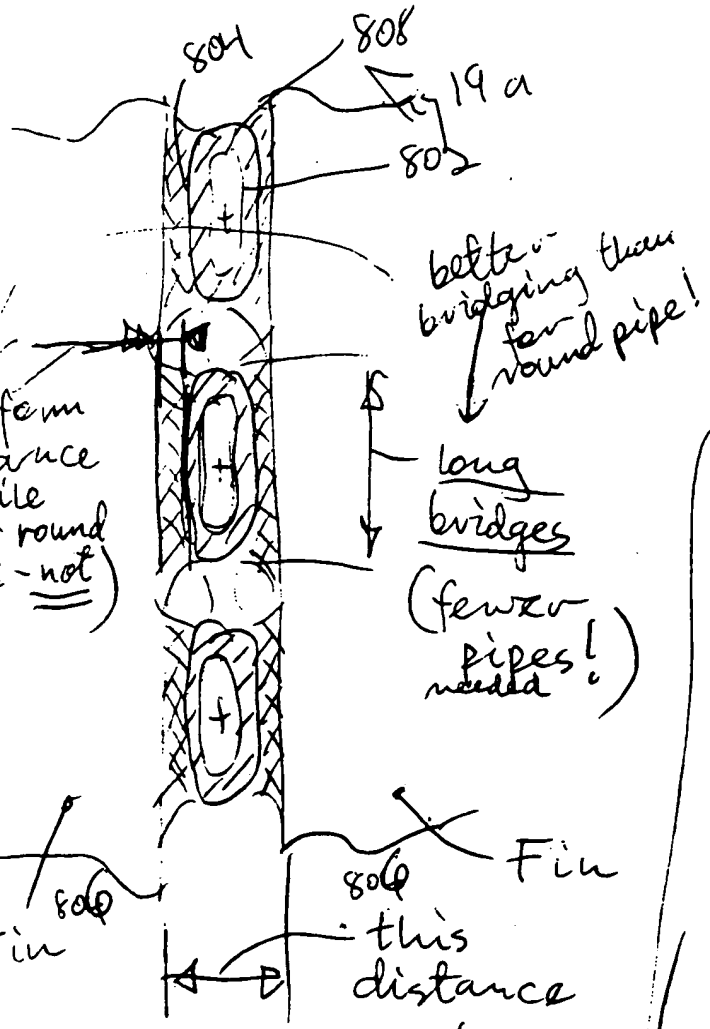


or combined

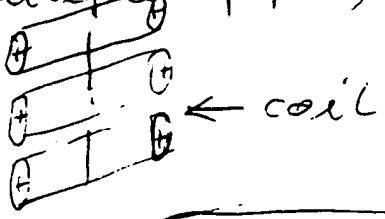


R.H.

flattened/oval/square pipes (continued)



(spiral/coil made of flattened pipes)



Flattened/shaped pipes could be further explored for example: a combination:

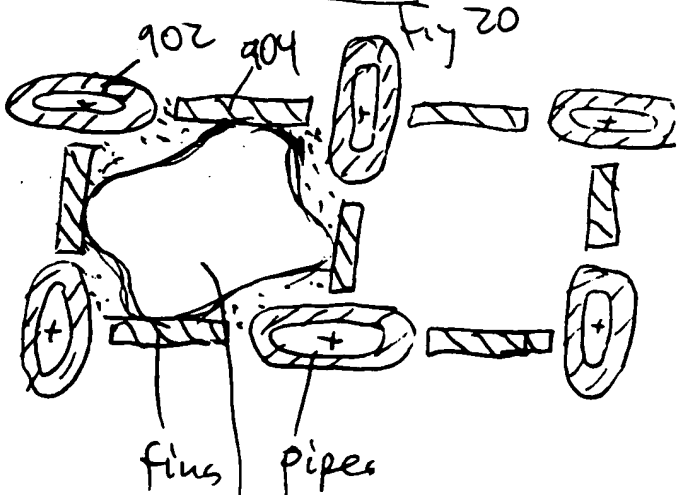
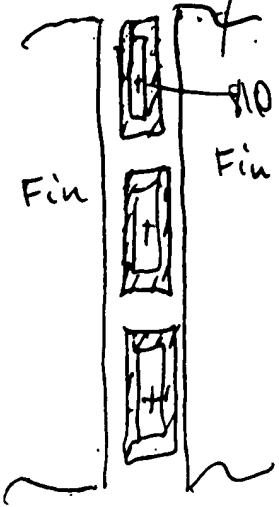


Fig 19b

square pipe - even better (uniform, long bridging)



Romboidal (diamond) freezing pattern

R.W.

Purpose - if certain compartmentization has to be done in large vessels.